



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 : B23Q 17/22, G01B 7/14	A1	(11) International Publication Number: WO 90/11162 (43) International Publication Date: 4 October 1990 (04.10.90)
(21) International Application Number: PCT/GB90/00298 (22) International Filing Date: 26 February 1990 (26.02.90) (30) Priority data: 8906220.2 17 March 1989 (17.03.89) GB 8919879.0 2 September 1989 (02.09.89) GB (71) Applicant (for all designated States except US): BENCERE LTD. [GB/GB]; Brewery Lane, Hook Norton, Banbury, Oxfordshire OX15 5NX (GB). (72) Inventor; and (75) Inventor/Applicant (for US only) : RYE, Martin, Cee [GB/GB]; Brewery Lane, Hook Norton, Oxfordshire OX15 5NX (GB). (74) Agent: STANLEY, Michael, Gordon; 86 Warwick Road, Banbury, Oxfordshire OX16 7AJ (GB).		(81) Designated States: AT (European patent), BE (European patent), CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB, GB (European patent), IT (European patent), JP, LU (European patent), NL (European patent), SE (European patent), US. Published <i>With international search report.</i>
(54) Title: GAUGE DEVICE (57) Abstract <p>A gauge (10, 110) for determining when an object, e.g. a cutting tool, is a predetermined distance (D) from a surface e.g. a machine tool surface. The gauge has a body (11, 111) having a datum base surface (41) for placing against said surface and a probe (16, 116) mounted in the body for axial movement and which has a contact surface (18, 118) for contact with the tool. An electrical circuit (C1 C2, C3 C4 C5) arranged within the body includes an indicator (33, 133) and a battery (26, 126) which are connected so that the indicator is operably connected internally of the body with the battery by the probe (16, 116) when the contact surface (18, 118) is a known distance (D) from the datum surface (41). The gauge is a self contained unit which does not use the machine tool as part of its electrical circuit.</p>		

DESIGNATIONS OF "DE"

Until further notice, any designation of "DE" in any international application whose international filing date is prior to October 3, 1990, shall have effect in the territory of the Federal Republic of Germany with the exception of the territory of the former German Democratic Republic.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	ES	Spain	MG	Madagascar
AU	Australia	FI	Finland	ML	Mali
BB	Barbados	FR	France	MR	Mauritania
BE	Belgium	GA	Gabon	MW	Malawi
BF	Burkina Faso	GB	United Kingdom	NL	Netherlands
BG	Bulgaria	HU	Hungary	NO	Norway
BJ	Benin	IT	Italy	RO	Romania
BR	Brazil	JP	Japan	SD	Sudan
CA	Canada	KP	Democratic People's Republic of Korea	SE	Sweden
CF	Central African Republic	KR	Republic of Korea	SN	Senegal
CG	Congo	LI	Liechtenstein	SU	Soviet Union
CH	Switzerland	LK	Sri Lanka	TD	Chad
CM	Cameroon	LU	Luxembourg	TG	Togo
DE	Germany, Federal Republic of	MC	Monaco	US	United States of America
DK	Denmark				

-1-

GAUGE DEVICE

This invention relates to gauges for determining when an object is a predetermined distance from a surface, and more particularly it relates to tool pre-setting devices for setting cutting tools on machine tools such as mills, lathes, turning centres, machining centres, rotary and line transfer machines, robotics and other applications.

10

There are prior art machine tool setting gauges in which a probe having a contact surface is resiliently mounted in a base, the gauge further including a battery and a lamp such that one pole of the battery earths through the base and the machine tool, and the other pole of the battery is connected to the probe so that the contact of the cutting tool against the probe completes the electrical circuit through the cutting tool and the machine tool and the lamp is switched on. Such devices are shown in US 3553671 and WO 86/05737.

20

Other similar devices operate with electrically inducted current flowing around the machine tool and through the cutting tool.

25

However, all these devices suffer from the disadvantage that they do not operate with non-conductive cutting

-2-

tools. Further in the event of an electrical resistance in the machine, caused by for example, non-conductive slideway surfaces, dirt, or oil film, etc., where high resistance is encountered the voltage supply to the
5 setting gauge has to be greatly increased to cause the lamp to illuminate.

Similarly the lamp will not operate if the cutting tool is held in a holder which rotates within nylon bearings,
10 or other electrically non-conductive materials, or the spindle is insulated from the rest of the machine.

Yet another disadvantage of the prior art systems is that they can be activated by very small droplets of cutting
15 fluid or water, such as might be caused by condensation, on the tips of a tool so that the conductive liquid completes the electrical circuit rather than direct tool contact.

20 The invention provides a gauge which overcomes the above difficulties.

Accordingly there is provided a gauge for determining when an object is a predetermined distance from a
25 surface, and which comprises a body having a datum base surface for placing against said surface; a probe mounted in the body for axial movement relative thereto, and

-3-

which has a contact surface for contact with said object;
an electrical circuit arranged within the body and
including an indicator means and a voltage source which
are connected so that the indicator means is operably
5 connected internally of the body with the voltage source,
by the probe when the contact surface of the probe is a
known distance from the datum surface.

Preferably the voltage source is a battery having one
10 pole connected to a first electrical contact on the probe
through the indicator means and its other pole connected
to a second electrical contact spaced from the first
contact and having an operative position fixed relative
to said body.

15 Conveniently, a portion of the probe is electrically
conductive and serves to operably connect the indicator
means and the voltage source when the contact surface is
at said known distance.

20 Said other pole may be connected to an earth formed by
the body of the gauge, or alternatively, said other pole
is connected to an contact button forming the second
electrical contact. When the two contacts meet they
25 close the electrical circuit.

The battery may be housed in a holder of electrically

-4-

non-conductive material having the contact located button at one end thereof, and said one pole of the battery is connected to the indicator means, preferably an LED, via a conductive cap which holds the battery in place.

5

The known distance at which the LED lights is determined by the addition of two independent dimensions, the distance between the contact surface on the probe and the first electrical contact, and the distance between the datum base surface and the second electrical contact.

10

The invention will be described by way of example and with reference to the accompanying drawings in which:

- 15 Fig 1 is a longitudinal cross-section through a first gauge according to this invention with a schematic of the electrical circuit shown on the drawing,
- Fig 2 is similar cross-section through a second gauge also according to this invention,
- 20 Fig 3 is a corss-section through a detail of Fig 2 showing a further modification.

Now with reference to the drawing, there is illustrated a gauge device 10 for determining when an object is a predetermined distance from a surface. This would normally be to pre-set a machine tool tip a known

25

-5-

distance from a work piece surface or other datum, so that its co-ordinates can be fed into a numerical control system.

- 5 The gauge has a cylindrical body 11 comprising a lower base 12 and an upper cap 13. The base 12 is made from an electrically conductive material and has a coaxial bore 14 therein.
- 10 The cap 13 is made of an electrically insulating material, for example, nylon, phenolic resin compounds or other suitable materials and also has a coaxial stepped bore 15 therein having a smaller diameter portion 15A uppermost and larger diameter portion 15B which opens
- 15 into the bore 14 in the abutting base 12. The bore 14 in the base has a larger diameter than the larger diameter portion 15B of the bore 15 in the cap.

- A probe 16, in the form of a stepped piston is mounted in
- 20 the cap 13 of the body 11, and is axially slideable in the stepped bore 15. The piston 16 comprises a larger diameter head portion 19, and a smaller diameter coaxial stem portion 17 which is electrically insulated from the head portion 19 by an insulator sleeve 39. The stem
- 25 portion 17 slides in the smaller diameter portion 15A of the stepped bore and has an upper end contact surface 18 for contact with a cutting tool tip, and the head portion

-6-

19 is slideable in the large diameter portion 15B of the stepped bore 15. Upward movement of the piston 16 is limited by abutment of the head portion 19 against the shoulder 20 between the two different diameter portions 15A, 15B of the stepped bore 15. The axially inner portion of the probe 16, ie. the head 19, is electrically conductive.

The bore 14 in the base 12 has its bottom end closed by a power source holder 22 which comprises a cylindrical head portion 23 which closes the bore 14 and an axially inwardly projecting smaller diameter coaxial spigot 24. An inwardly extending coaxial blind bore 25 is formed in the holder 22 and extends into the spigot 24. This serves to house a voltage or EMF source 26 e.g. a battery, and has its axially outer end closed by a screw cap 27. The holder 22 and screw cap 27 are both made of an electrically conductive material.

Located in the bore 14, between the holder 22 and the cap 13 is a cylindrical contact member 28 which is in the form of an inverted cup shaped plunger and which is made from an electrically conductive material. The contact member 28 is slideable in the bore 14 and is mounted over the spigot 24 which extends into the contact member 28. A resilient means, in the form of a compression spring 29 is fitted over the spigot 24 and serves to bias the

-7-

contact member 28 upwardly into an operative position. The upward movement of the contact member 28 is limited by abutment with the cap 13. A wear plate 31 may be inserted into the cap to prevent the contact member 28
5 from gradually wearing away the insulating cap 13 and causing inaccuracies in the gauge.

A second resilient means, spring 32, of a lower stiffness value than the spring 29, acts between the contact member
10 28 and the probe 16 to bias the probe axially upwardly until the head 19 of the probe abuts the shoulder 20. The spring 32 is of an electrically conductive material.

On the upper external surface of the cap 13, there is
15 located an indicator means 33 which is preferably a light emitting diode (LED) lamp, but could be other suitable means such as a sound emitter, a radio signal transmitter, or other indicative signal generators. The LED lamp 33 is connected by a first electrical circuit C1
20 to a contact 34 which is directly in contact with one pole of the battery 26. The contact 34 is insulated from the power source holder 22 by an insulator ring 35. The LED 33 is also connected by a second electrical circuit C2 to a second contact 36 which is housed coaxially in
25 the upper surface of the contact member 28. The contact 36 is isolated from the contact member 28 by a second insulator ring 37 but is electrically connected to the

-8-

probe head 19 which constitutes a first electrical contact.

5 The probe 16 may have a hardened insert 38 in its outer contact surface 18 to prevent wear and damage to the surface. The contact surface 18 is electrically insulated from the head portion 19 of the probe 16 by the sleeve 39 to prevent reverse electrical contact through the machine and cutting tool.

10

The base 12 has a bottom datum surface 41, which may have magnetic inserts 40 therein for holding the gauge to a working ferrous metal surface such as a machine bed or other working datum surface.

15

The battery 26 has one pole earthed to base 12 of the body of the gauge via the screw cap 27, and holder 22. The cap 27, holder 22, base 12 and contact member 28 are therefore all at the same electrical potential. The
20 contact member 28 constitutes a second electrical contact which co-operates with the first contact formed by the probe head 19. The other pole of the battery 26 is connected through the electrical circuit C1, LED lamp 33, electrical circuit C2, and spring 32, to the head 19
25 of the probe 16. The head 19, at the electrical potential of said other pole of the battery, is isolated from earth by the non-conductive cap 13 and sleeve 39.

-9-

When the tip of a cutting tool is brought into contact with the contact surface 18 of the probe 16 and causes the probe to move axially inwardly, the LED lamp 33 will light up when the head portion 19 of the probe contacts
5 the uppermost surface of the contact member 28 and completes the electrical circuit. The linear dimension D at which point the lamp 33 illuminates is predetermined and its co-ordinates can be entered into the controls of a numerically controled machine tool, or into the offset
10 registers within other programmable devices, to preset the cutting tool.

If the machine tool tip overtravels, the contact member 28 can move axially downwardly against the bias of the
15 spring 29 to absorb the overtravel and thereby prevent damage to the cutting tool, machine, or the gauge.

When the gauge is mounted onto a machine, or datum surface, the base 12 will make electrical contact with
20 the machine working surface assuming that it is say steel and of course it will be at the same potential as the base 12. Therefore, in certain circumstances, a reverse electrical circuit may be set up throught the machine to the tool tip. The insulator sleeve 39 acts to prevent
25 the LED lamp 33 from lighting on contact of the cutting tool with the probe contact surface 18.

-10-

The guage is a self contained unit which does not rely on external electrical circuits set up through machine tools, or an external power source.

- 5 The probe 16 could have a screw adjustable insert (not shown) to allow the gauge to be selectively set for different known distances.

Now with reference to Fig 2, there is illustrated a gauge
10 device 110 which is similar to that illustrated in Fig 1. The gauge 110 has a body 111 comprising a base 112 and a cap 113. The base 112 is formed from a magnetizable material, for example mild steel, and has a coaxial bore 114 therein.

15

The cap 113 is made of an electrically insulating material as before, and also has a coaxial stepped bore 115 therein having a smaller diameter portion 115A uppermost and larger diameter portion 115B which opens
20 into the bore 114 in the base. The smaller diameter portion is lined with an electrically conductive bush 139, preferably a brass bush. The bore 114 in the base has a larger diameter than the larger diameter portion 115B of the bore 115 in the cap 113.

25

The probe or piston 116, is a stepped piston mounted in the bush 139 in the cap 113, and is axially slideable in

-11-

the stepped bore 115. The piston 116 has a smaller diameter coaxial hollow stem 117 which extends through the smaller diameter portion 115A of the stepped bore and has an upper end contact surface 118 for contact with a machine tool tip, and larger diameter head 119 fixed into the hollow stem and which is slideable in the large diameter portion 115B of the stepped bore 115. The head 119 is made of electrically conductive material. Upward movement of the piston 116 is limited by abutment of the head 119 against the shoulder 120 between the two different diameter portions of the stepped bore 115.

Also located in the hollow stem 117 of the piston 116 is an electrically conductive contact 136 forming the first electrical contact and which is biased downwards by a spring 141. The contact 136 projects through a bore 137 in the center of the head 119 and has a shoulder 138 which limits its downwards movements.

The bore 114 in the base 112 houses a power source holder 122 which unlike the previous embodiment is made from an electrically insulating material. The holder 122 has a radially outwardly projecting flange 123 on its outer surface, which locates between a flange 121 on the base 122 and the cap 113. A coaxial bore 125 is formed in the holder 122 which houses a power source 126 e.g. a battery, and has its axially outer end closed by an

-12-

electrically conductive screw cap 127 and its inner end closed by an electrically conductive contact button 128 forming the second electrical contact. The spring 129 makes an electrical connection between a pole of the
5 battery 126 and the contact button 128.

A resilient means, in the form of a compression spring 132 is housed in the bore 115, and acts between the holder 122 and the piston 116 to bias the piston 116
10 upwardly until the head 119 abuts the shoulder 120.

On the upper external surface of the cap 113, there is located an LED indicator means 133 as previously described.

15

The LED 133 is connected by a first electrical wire C3 to an annular conductive plate 134 such as a brass plate fitted to the flange 123 of the holder 122. The connection between the wire C3 in the cap and the plate
20 134 is made through a spring 135. The plate 134 is connected by a wire C4 to the screw cap 127 and hence to one pole of the battery 126. The LED 133 is also connected by an electrical wire C5 to the bush 139 and then via the piston 116, head 119, spring 141 to the
25 contact 136 so that the contact 136 is at the same potential as the screw cap 127. The other pole of the

-13-

battery is connected via spring 129 to the contact button 128.

The bottom datum surface 41 on the base 112 has magnetic
5 inserts 40 therein for holding the gauge to a machine
bed. In this embodiment, the magnetic inserts 40 are
recessed into the base.

When the tip of a tool is brought into contact with the
10 upper surface 118 of the probe 116 and causes the probe
to move axially inwardly the LED lamp 133 will light up
when the contact 136 the uppermost surface of the contact
button 128 and completes the electrical circuit. The
linear dimension D at which point the lamp 133
15 illuminates is predetermined and its co-ordinates can
feed into the controls of a numerically controlled
machine tool to present the cutting tool. The distance D
is determined by a simple addition of the two independant
distances D1 and D2. D1 is the distance between the
20 contact surface 118 and the end of the contact 136 in its
most downward position, and D2 is the distance between
the datum base surface 41 and the upper surface of the
contact button 128. Hence any tolerances related to
dimensions of the cap 113 and base 112 can be absorbed.

25

If desired, the two dimensions D1 and D2 can be
predetermined to sum to for example 50 mm. In this case

-14-

the datum surface 41 base 112 can be machined down until the LED lights up at the desired 50 mm dimension.

If the machine tool tip overtravels, the contact 136 can
5 move axially upwardly against the bias of the spring 141 to absorb the overtravel and thereby prevent damage.

In a further embodiment of the invention, a screw adjustable electrically conductive contact pad 150 can be
10 mounted in the contact button 128 so that the probe 116 can be moved inwardly until the upper surface 118 and the datum surface 41 are a known distance apart e.g. 50 mm and the contact pad 150 is adjusted by screwing axially in or out until the LED just lights. To perform
15 this operation the battery 126 is removed and power is fed into the gauge by a plug in device that allows access to the contact pad.

20

25

-15-

CLAIMS

1. A gauge for determining when an object is a predetermined distance from a surface, and which comprises a body having a datum base surface for placing
5 against said surface, a probe mounted in the body for axial movement relative thereto, and which has a contact surface for contact with said object, an electrical circuit arranged within the body and including an indicator means and a voltage source which are connected
10 so that the indicator means is operably connected internally of the body with the voltage source by the probe, when the contact surface of the probe is a known distance from the datum surface.
- 15 2. A gauge as claimed in Claim 1 wherein the voltage source has one pole connected to a first electrical contact on the probe through the indicator means, and its other pole connected to a second electrical contact spaced from the first contact and having an operative
20 position fixed relative to the body.
3. A gauge as claimed in Claim 1 or Claim 2 wherein said body comprises a base having a bore therein, an insulating coaxial cap at the upper end of the base in
25 which the probe is axially slideably mounted, a first electrical contact on the probe being connected to one pole of the voltage source, and a contact member forming

-16-

a second electrical contact located in the bore of the base and which is connected to the other pole of the voltage source, said indicator means becoming operative when the two contacts meet.

5

4. A gauge as claimed in any one of Claims 1 to 3 wherein at least a portion of the probe is electrically conductive and said portion completes the electrical circuit between the indicator means and the voltage
10 source when the contact surface is at said known distance.

5. A gauge as claimed in Claim 2 and Claims 3 or 4 when dependant upon Claim 2, wherein the two electrical
15 contacts are biased apart by a first spring, and at least one of the electrical contacts is biased towards the other contact by a second spring so that the both contacts can move together relative to one of the piston and body after closing to prevent damage.

20

6. A gauge as claimed in Claim 3, and Claim 4 or Claim 5 when dependant upon Claim 3, wherein the voltage source is a battery held in a battery holder forming part of the base and located in the bore in the base with at least a
25 portion of the battery holder forming part of the electrical circuit within the gauge.

-17-

7. A gauge as claimed in Claim 5 or Claim 6 wherein the voltage source is a battery and the second electrical contact connected to said other pole is electrically connected to an electrical earth formed by a portion of
5 the body.

8. A gauge as claimed in Claim 7 wherein the probe is slideably mounted in the body and is insulated from said earth and an inner portion of the probe is electrically
10 conductive and forms said first electrical contact, the inner surface of the probe connecting to earth when the contact surface is at said known position.

9. A gauge as claimed in Claim 8 wherein said contact
15 surface is insulated from the inner portion of the probe to prevent the indicator device and voltage source being externally connected between the probe and base.

10. A gauge as claimed in any one of Claims 7, 8, or 9,
20 wherein the second electrical contact is resiliently biased towards the probe and cap by said second spring to be held in the operative position spaced from the probe and electrically insulated therefrom, the second electrical contact being moveable against the resilient
25 bias of the second spring in event of further axial movement of the probe after contact of the probe against said contact member.

-18-

11. A gauge as claimed in Claim 10 wherein said second electrical contact is an electrically conductive plunger slideable within the bore in the base, and biased away from the battery holder by said second spring.

5

12. A gauge as claimed in any one of Claims 7 to 11 when dependant upon Claim 6, wherein the battery holder is electrically conductive and is in contact with the base such that the base, holder and second electrical contact
10 are all connected to form an earth for said other pole of the battery, said one pole of the battery being insulated from earth and being connected to the first contact, the probe being resiliently biased away from the second electrical contact by the first spring which is also
15 electrically conductive and which connects first contact on the probe with said one pole of the battery.

13. A gauge as claimed in Claim 5 or Claim 6 wherein the voltage source is a battery and is held in a battery
20 holder made of a non conductive material and the battery holder has an electrically conductive cap which holds the battery in place and contacts one pole of the battery and is connected to the first electrical contact on the probe via the indicator means, and an electrical contact button
25 is located at the other end of the battery holder and is connected to the other pole of the battery to form the second electrical contact.

-19-

14. A gauge as claimed in Claim 13 wherein the whole probe is electrically conductive and is hollow with the first electrical contact slideably located within the hollow plunger and biased to its operative position by the second spring also located within the hollow probe.

15. A gauge as claimed in any one of Claims 2 to 14 wherein the known distance at which the indicator means operates is derived from two independant dimensions.

10

16. A gauge as claimed in Claim 15 wherein the two independant dimensions are the distance between the contact surface on the probe and the first electrical contact on the probe, and the distance between the datum surface and the second electrical contact when in its operative position.

17. A gauge as claimed in any one of Claims 1 to 16 wherein the gauge has an adjuster means to selectively preset the gauge so that the indicator means operates at a predetermined known distance which is variable through the adjuster means.

18. A gauge as claimed in Claim 17 when dependant upon Claim 13, wherein the contact button has a screw threaded contact pad therein that can be selectively adjusted to cause the indicator means to operate when the two

-20-

dimensions are summed to a predetermined value.

19. A guage as claimed in any one of Claims 1 to 18
wherein the indicator means is a light emitting, audible
5 or radio frequency transmitting device.

20. A guage as claimed in any one of Claims 1 to 19
wherein magnets are inserted into the datum base surface
of the body to hold the gauge against a machine work
10 surface of ferrous metal.

15

20

25

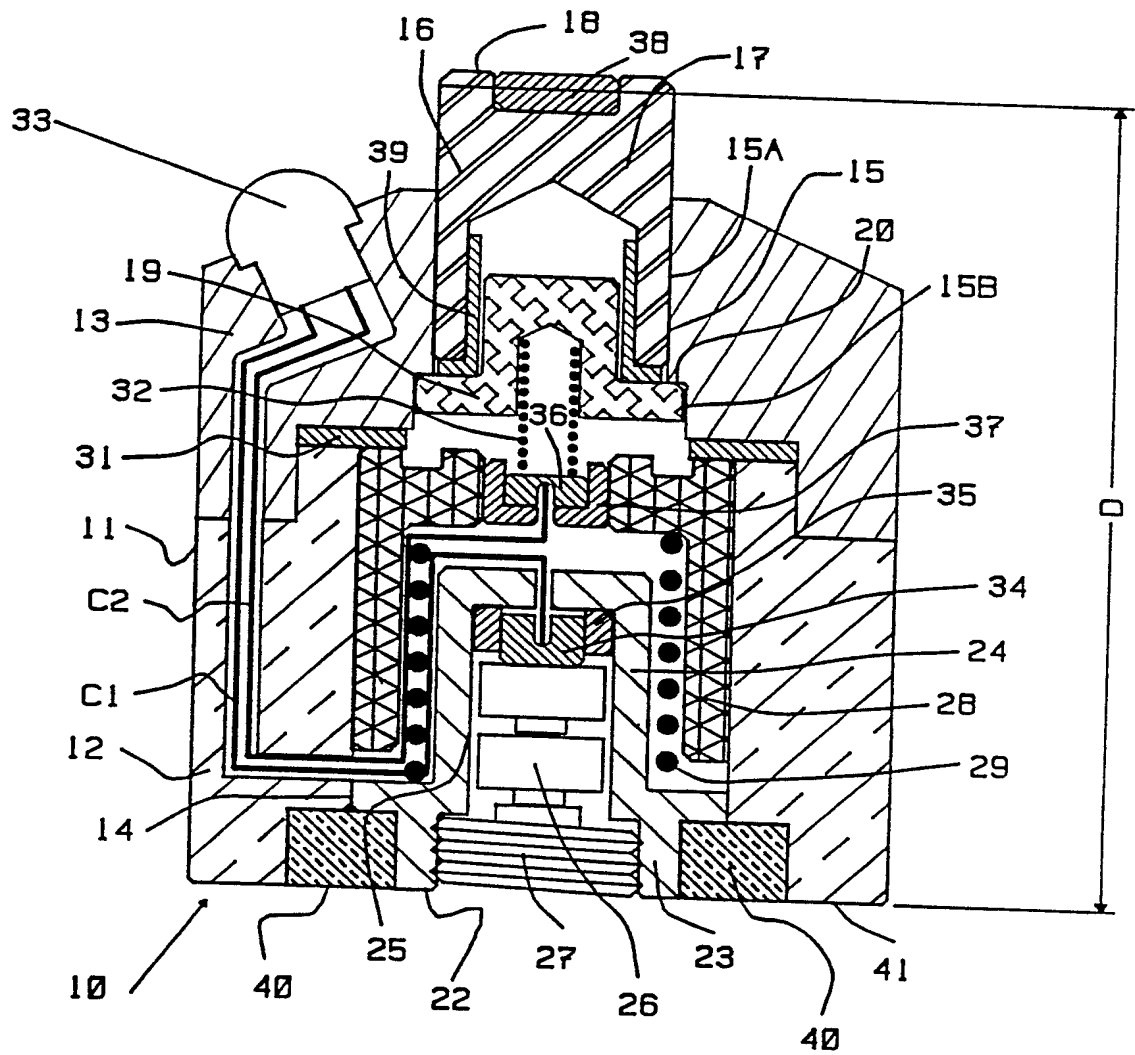
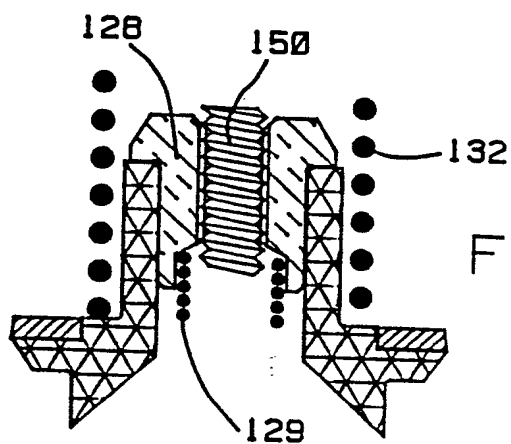
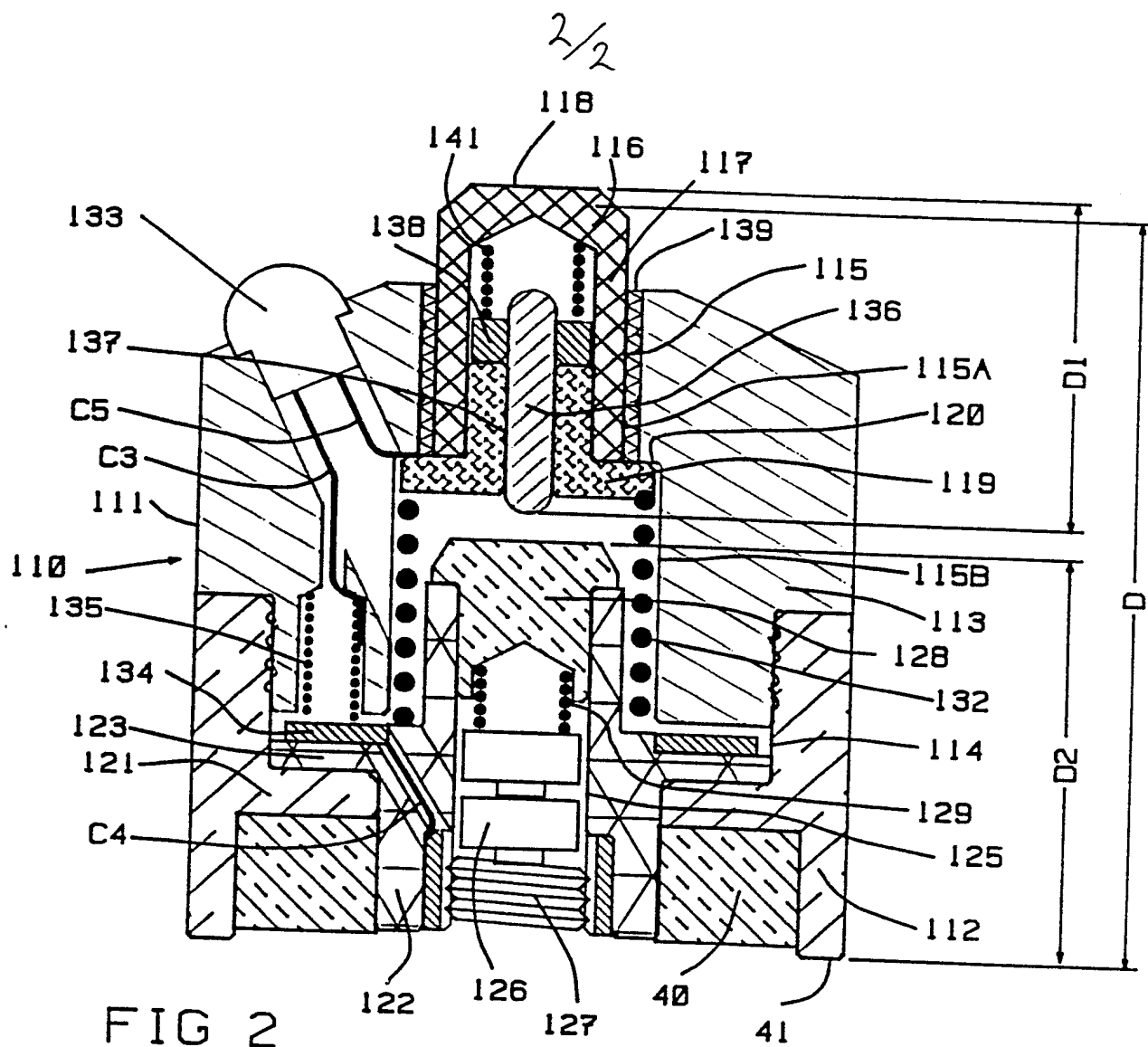
$\frac{1}{2}$ 

FIG. 1



INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 90/00298

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply indicate all) ⁶ According to International Patent Classification (IPC) or to both National Classification and IPC IPC ⁵ : B 23 Q 17/22, G 01 B 7/14																	
II. FIELDS SEARCHED <div style="text-align: center; font-size: small;">Minimum Documentation Searched ⁷</div> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none;">Classification System :</td> <td style="width: 50%; border: none;">Classification Symbols</td> </tr> </table> IPC ⁵ G 01 B 7/00, B 23 Q 17/00 <div style="text-align: center; font-size: x-small;">Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸</div>			Classification System :	Classification Symbols													
Classification System :	Classification Symbols																
III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁹ <table style="width: 100%; border: none;"> <tr> <th style="width: 10%; font-size: x-small;">Category ¹⁰</th> <th style="width: 70%; font-size: x-small;">Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²</th> <th style="width: 20%; font-size: x-small;">Relevant to Claim No. ¹³</th> </tr> <tr> <td style="vertical-align: top; padding: 5px;">Y</td> <td style="vertical-align: top; padding: 5px;"> WO, A, 86/05735 (INDUSTRIVERKTYG AB) 9 October 1986 see the whole document (cited in the application) <div style="text-align: center;">--</div> </td> <td style="vertical-align: top; padding: 5px;"> 1,2,4-7,10, 12,15-17,19 </td> </tr> <tr> <td style="vertical-align: top; padding: 5px;">Y</td> <td style="vertical-align: top; padding: 5px;"> EP, A, 0225666 (OCE-NEDERLAND B.V.) 16 June 1987 see the whole document <div style="text-align: center;">--</div> </td> <td style="vertical-align: top; padding: 5px;"> 1,2,4-7,10, 12,15-17,19 </td> </tr> <tr> <td style="vertical-align: top; padding: 5px;">X</td> <td style="vertical-align: top; padding: 5px;"> GB, A, 589364 (KAPELLA LTD) 18 June 1947 see page 3, line 5 - page 4, line 99; figures 1-3 <div style="text-align: center;">--</div> </td> <td style="vertical-align: top; padding: 5px;"> 1,2,4,15,16, 19 </td> </tr> <tr> <td style="vertical-align: top; padding: 5px;">A</td> <td style="vertical-align: top; padding: 5px;"> US, A, 3553671 (W.J. HOPKINS) 5 January 1971 see the whole document, especially figures 3,4; column 2, lines 10-15; column 3, lines 2-32, lines 60-62; ./. <div style="text-align: center;">--</div> </td> <td style="vertical-align: top; padding: 5px;"> 1,2,4,6,11, 13-19 </td> </tr> </table>			Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³	Y	WO, A, 86/05735 (INDUSTRIVERKTYG AB) 9 October 1986 see the whole document (cited in the application) <div style="text-align: center;">--</div>	1,2,4-7,10, 12,15-17,19	Y	EP, A, 0225666 (OCE-NEDERLAND B.V.) 16 June 1987 see the whole document <div style="text-align: center;">--</div>	1,2,4-7,10, 12,15-17,19	X	GB, A, 589364 (KAPELLA LTD) 18 June 1947 see page 3, line 5 - page 4, line 99; figures 1-3 <div style="text-align: center;">--</div>	1,2,4,15,16, 19	A	US, A, 3553671 (W.J. HOPKINS) 5 January 1971 see the whole document, especially figures 3,4; column 2, lines 10-15; column 3, lines 2-32, lines 60-62; ./. <div style="text-align: center;">--</div>	1,2,4,6,11, 13-19
Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³															
Y	WO, A, 86/05735 (INDUSTRIVERKTYG AB) 9 October 1986 see the whole document (cited in the application) <div style="text-align: center;">--</div>	1,2,4-7,10, 12,15-17,19															
Y	EP, A, 0225666 (OCE-NEDERLAND B.V.) 16 June 1987 see the whole document <div style="text-align: center;">--</div>	1,2,4-7,10, 12,15-17,19															
X	GB, A, 589364 (KAPELLA LTD) 18 June 1947 see page 3, line 5 - page 4, line 99; figures 1-3 <div style="text-align: center;">--</div>	1,2,4,15,16, 19															
A	US, A, 3553671 (W.J. HOPKINS) 5 January 1971 see the whole document, especially figures 3,4; column 2, lines 10-15; column 3, lines 2-32, lines 60-62; ./. <div style="text-align: center;">--</div>	1,2,4,6,11, 13-19															
<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; vertical-align: top; font-size: x-small;"> [*] Special categories of cited documents: ¹⁰ "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed </td> <td style="width: 50%; vertical-align: top; font-size: x-small;"> "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "&" document member of the same patent family </td> </tr> </table>			[*] Special categories of cited documents: ¹⁰ "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "&" document member of the same patent family													
[*] Special categories of cited documents: ¹⁰ "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "&" document member of the same patent family																
IV. CERTIFICATION <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none; vertical-align: top;"> Date of the Actual Completion of the International Search 14th June 1990 </td> <td style="width: 50%; border: none; vertical-align: top;"> Date of Mailing of this International Search Report <div style="font-size: large; font-weight: bold;">16 JUL. 1990</div> </td> </tr> <tr> <td style="width: 50%; border: none; vertical-align: top;"> International Searching Authority EUROPEAN PATENT OFFICE </td> <td style="width: 50%; border: none; vertical-align: top;"> Signature of Authorized Officer <div style="text-align: center;"> H. T. TAZELAAR </div> </td> </tr> </table>			Date of the Actual Completion of the International Search 14th June 1990	Date of Mailing of this International Search Report <div style="font-size: large; font-weight: bold;">16 JUL. 1990</div>	International Searching Authority EUROPEAN PATENT OFFICE	Signature of Authorized Officer <div style="text-align: center;"> H. T. TAZELAAR </div>											
Date of the Actual Completion of the International Search 14th June 1990	Date of Mailing of this International Search Report <div style="font-size: large; font-weight: bold;">16 JUL. 1990</div>																
International Searching Authority EUROPEAN PATENT OFFICE	Signature of Authorized Officer <div style="text-align: center;"> H. T. TAZELAAR </div>																

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category *	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages	Relevant to Claim No.
	claims 4,5,6, (cited in the application) --	
A	DE, A, 3737471 (R.W. CADDELL) 19 May 1988 see the whole document --	1,3,11,15,16
A	EP, A, 0076865 (H. LETZEL) 20 April 1983 see the whole document -----	1,3,11,15,16

**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.**

GB 9000298
SA 34817

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 06/07/90
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO-A- 8605735	09-10-86	AU-A- 5667986 EP-A- 0216890 JP-T- 62502676 SE-A- 8501606 US-A- 4826370	23-10-86 08-04-87 15-10-87 24-11-86 02-05-89
EP-A- 0225666	16-06-87	NL-A- 8503363 JP-A- 62135701 US-A- 4734684	01-07-87 18-06-87 29-03-88
GB-A- 589364		None	
US-A- 3553671	05-01-71	FR-A- 2045550 CH-A- 504934 DE-A- 1913388	05-03-71 31-03-71 24-09-70
DE-A- 3737471	19-05-88	US-A- 4750272 JP-A- 63134150	14-06-88 06-06-88
EP-A- 0076865	20-04-83	None	